IS 10210 (1993): Criteria for Design of Hydraulic Hoists for Gates [WRD 12: Hydraulic Gates and Valves]

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IS 10210 : 1993

(Reaffirmed 2004)

भारतीय मानक

दरवाजों के लिए द्रव चालित उच्चालकों के डिज़ाइन मापदण्ड

(पहला पुनरीक्षण)

Indian Standard

CRITERIA FOR DESIGN OF HYDRAULIC HOISTS FOR GATES

(First Revision)

UDC 626·422·43 : 621·87

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Price Group 6

Hydraulic Gates and Valves Sectional Committee, RVD 12

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Hydraulic Gates and Valves Sectional Committee had been approved by the River Valley Division Council.

Hydraulic hoists are used for operating various types of gates and valves installed in hydraulic structures. It is important to ensure that these hoists work smoothly and efficiently so that the gates and valves may be operated flawlessly at critical operation time. This standard, provides guidance for design of hydraulic hoists and their components for some common types of gates.

This standard was first published in 1982. This revision has been prepared in the light of the experience gained during the last 10 years in the use of this standard. The salient features of this revision are given below:

a) It was felt that cylinder need not be designed for 1·25 times design pressure.

b) Grade of corrosion resistant steel has been specified.

c) In Table 1 Synthetic PTFE is included for materials of piston rings.

d) A new clause on lifting of penstock gate has been added.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

CRITERIA FOR DESIGN OF HYDRAULIC HOISTS FOR GATES

(First Revision)

1 SCOPE

1.1 This standard lays down the criteria for design of hydraulic hoists used for operation of hydraulic gates.

2 REFERENCES

2.1 The Indian Standards listed in Annex A are necessary adjuncts to this standard.

3 GENERAL

3.1 A hydraulic hoist consists of a cylinder with upper and lower cylinder head, piston and stem passing through a packing in the lower cylinder head. The hoists are operated by a motor and oil pump arrangement with the directional control by valves which are actuated by electric contacts from any desired position. Wherever necessary, diesel/manual drive for oil pump may also be provided.

3.2 The typical general arrangement of hydraulic hoists for some common types of gates are shown in Fig. 1 to Fig. 6.

4 CHOICE OF HYDRAULIC HOIST

4.1 The following factors generally govern the choice of hydraulic hoists:

a) High capacity and low travel,
b) Larger range of hoisting/lowering speed,
c) Limited space availability,
d) Dampening of vibrations of gates, and
e) Requirement of positive thrust.

5 HOIST CAPACITY

5.1 The capacity of the hoist should be based on the algebraic sum of the following:

a) All weights consisting of:
   1) gate leaf along with its components including ballast, if any; and
   2) moving parts of hoist like intermediate stems, gate stem, piston, etc.
b) Water load on gate components including buoyancy, wherever necessary.
c) All frictional forces comprising of:
   1) wheel/sliding friction;
   2) guide friction;
   3) trunnion friction, if hoist is used for radial gates;
   4) seal friction including bearing pad friction in case of slide gates; and
   5) friction of moving parts of hoist.
d) Any hydrodynamic load like hydraulic downpull/uplift.
e) Silt and ice load, wherever encountered.
f) Seating load as given below:

Type of Gate	*Minimum Seating Load*
Low head fixed wheel gates or radial gates for spillway crest	2.5 kN/m length of gate
Medium head gates	5.0 kN/m length of gate
High head sluice gates High head radial gates	10.0 kN/m length of gate

g) Any other consideration specific to a particular site.

5.2 The worst combination of the above forces during either lowering or raising cycle should be considered.

5.3 The hoist capacity arrived at in accordance with **5.2** should be increased by at least 20 percent as reserve.

6 MATERIAL AND DESIGN STRESSES

6.1 The recommended materials and design stresses for various components of hydraulic hoist should be as given in Table 1. Where no material has been specified, the best material available for the purpose, conforming to the relevant Indian Standard should be used.

7 DESIGN PRESSURE

7.1 A maximum design pressure 20 N/mm^2 may be considered in the design.

8 DESIGN OF HOIST COMPONENTS

8.1 Cylinder

8.1.1 *Operating Pressure*

The operating oil pressure in the hydraulic cylinder should be taken as design pressure in accordance with **7.1**.

8.1.2 *Design Procedure*

The design of cylinder and cylinder flanges may be carried out according to the procedure given in IS 2825 : 1969. The additional force due to fixity of the cylinder should also be considered.

8.2 Cylinder Head

8.2.1 The cylinder head should be designed as a thick flat plate, held down at the outer perimeter, in accordance with IS 2825 : 1969. In calculation, the extra strength due to the shape of the head may be neglected.

Table 1 Materials and Design Stresses for the Components of Hydraulic Hoist
(*Clause* 6.1)

Sl No.	Component Part	Recommended Material	Reference Specification	Allowable Design Stress
(1)	(2)	(3)	(4)	(5)
i)	Support frame	Structural steel	IS 226 : 1975 IS 808 : 1964 IS 2062 : 1980 IS 8500 : 1977	0.5 YP
	Cast steel		IS 1030 : 1982	0.55 YP
ii)	Cylinder	a) Plate steel b) Carbon steel forging	IS 2002 : 1982 IS:2041-1982 IS 2004 : 1978	0.30 YP
iii)	Upper and lower cylinder head	a) Structural steel b) Cast steel	IS 2002 : 1982 IS 2062 : 1992 IS 1030 : 1974	0.25 YP
iv)	Piston stem	a) Corrosion resistant steel b) Forged steel	IS 1570(Part 5) :1985 18% Cr minimum IS 2004 : 1978	0.40 YP
v)	Piston	a) Cast steel b) Forged steel c) Grey iron casting	IS 1030 : 1989 IS 2004 : 1978 IS 210 : 1978	0.25 YP
vi)	Piston ring	a) Bronze b) Grey iron casting c) Synthetic PTFE	IS 318 : 1962 IS 210 : 1978	0.25 UTS
vii)	Clevis pin	Corrosion resistant	IS 1570 (Part5) : 1985 (18% minimum Chromium) IS 6911 : 1972	0.30 YP
viii)	Gland, clevis bushing	Cast manganese bronze Synthetic PTEF		0.30 YP
ix)	Studs and bolts	Mild steel	IS 1367 : 1967	

8.2.1.1 The cylinder head thickness should be computed as below :

a) Cylinder head (circular flat plate without hole at its centre)

$$Max\ \sigma_r = Max\ \sigma_t = \frac{3\,w\,a^2\,(m+1)}{8\,mt^2}$$

b) Cylinder head(circular flat plate without hole at its centre)at outer edge

$$Max\ \sigma_r = \frac{3w}{4\,t^2}\,[a^2 - 2b^2] +$$

$$\frac{b^4\,(m-1) - 4\,b^4\,a\,(m+1)\log b + a^2\,b^2\,(m+1)}{a^2\,(m-1) + b^2\,(m+1)}$$

at inner edge

$$Max\ \sigma_r = \frac{3W\,(m^2-1)}{4\,mt^2}\left[\frac{a^4 - b^4 - 4\,a^2\,b^2\log a/b}{a^2\,(m-1) + b^2\,(m+1)}\right]$$

where

a = outer radius in cm,

b = inner radius in cm,

m = reciprocal of Poisson's ratio,

σ_t = tangential stress at surface of plate,

r = radial stress at surface of plate,

t = thickness of plate in cm,

w = pressure in N/mm^2.

The greater of the two stresses should be used to determine the thickness of cylinder head.

8.2.2 When bonnet cover is provided to work as one of the cylinder heads, it should be designed in accordance with IS 9349 : 1979.

8.3 Stems

8.3.1 *Piston Stem*

The piston stem should be of solid or hollow construction and if made of forged steel should be hard chromium plated to at least 0.05 mm thickness with stress limited to 0.4 of yield point at pressure setting of pump relief valve. In the case of double acting hoist the stem is to be checked for buckling.

8.4 Couplings

8.4.1 The couplings (*see* Fig. 7) for connecting the stems between the gate and hoist may be any of the following types depending upon suitability:

a) *Clevis type of coupling*— The male and female parts of clevis should be connected by steel pin. The pin should be designed against shear, bending and bearing. Adequate width of clevis should be kept so that the stresses in the jaws do not exceed the permissible bearing stresses;

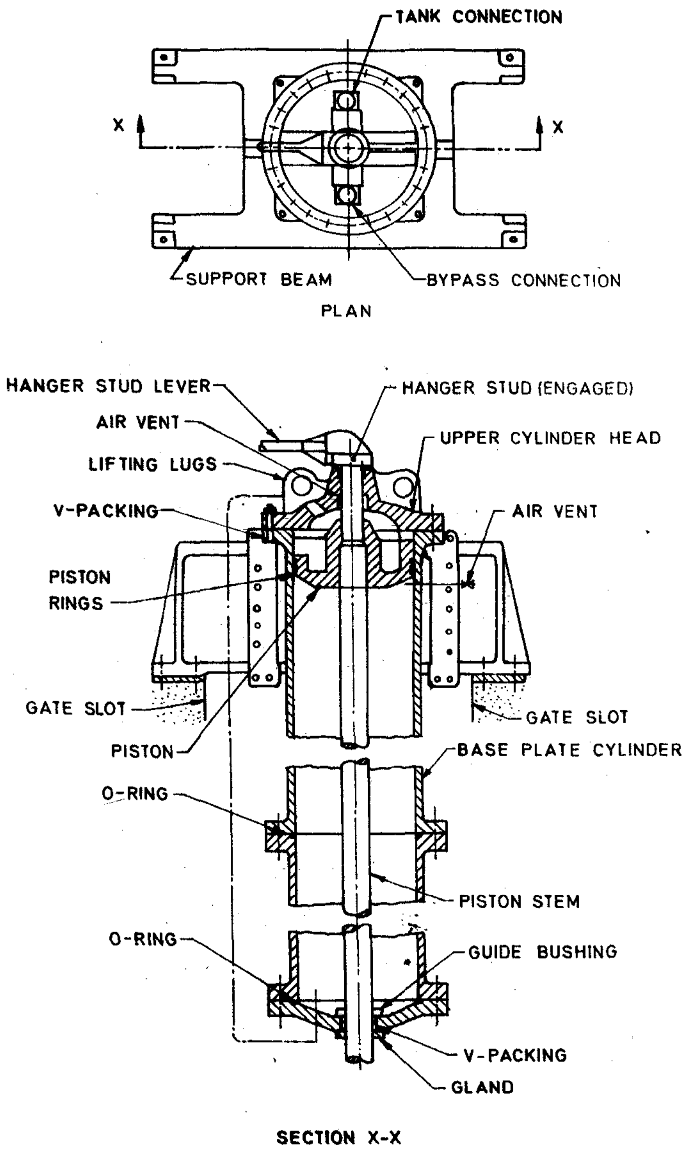


FIG. 1 TYPICAL ARRANGEMENT OF HYDRAULIC HOIST FOR AN INTAKE GATS

b) *Split collar type coupling*—This coupling which is more convenient to assemble and disassemble, can be used for vertical stem gates and for gates on slopes of more than about 15° with vertical, when aligned and supported on carriage brackets having wheels which run on tracks; and

c) *Hook and eye type coupling* — This type of coupling is suitable for gate on slopes of about 15° with vertical. This is similar to Clevis type of coupling except the addition of skid pads on the loop of the hook to provide an easy method of holding the stem for alignment on the slope. The smooth concrete surface on the face of the structure can provide an adequate bearing surface for the pads.

8.5 Piston

8.5.1 The piston should be designed for operating pressure. The steel piston should be provided with a suitable protection so that the finished piston may not affect the smooth cylinder walls.

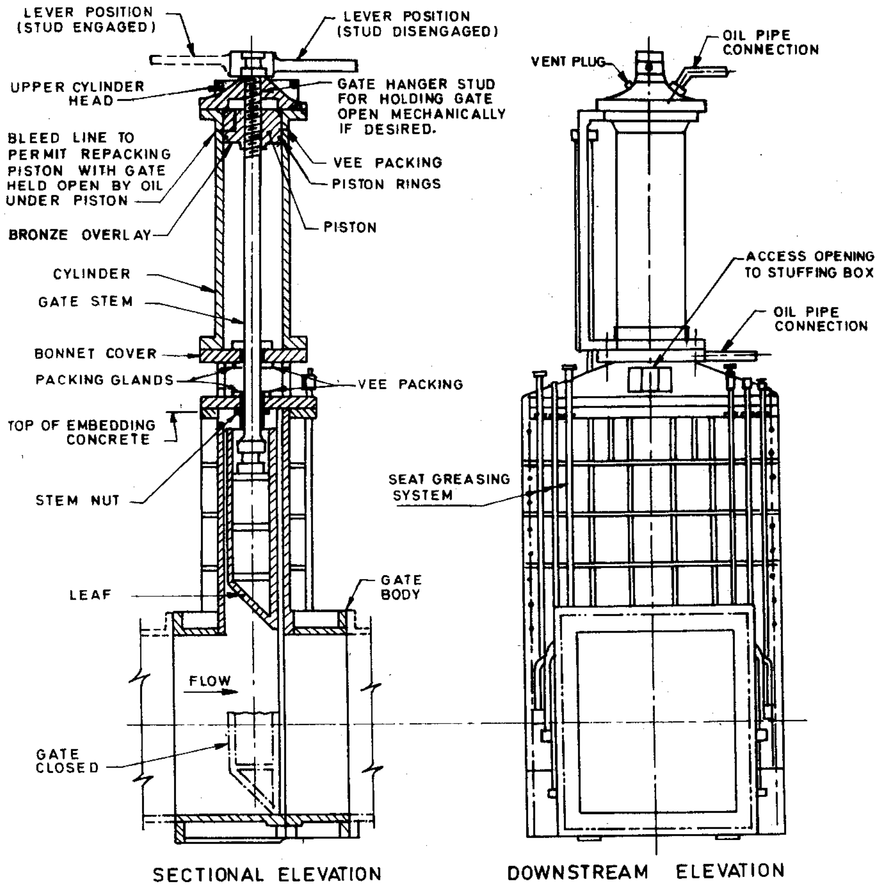


FIG. 2 TYPICAL ARRANGEMENT OF HYDRAULIC HOIST FOR SLIDE GATE

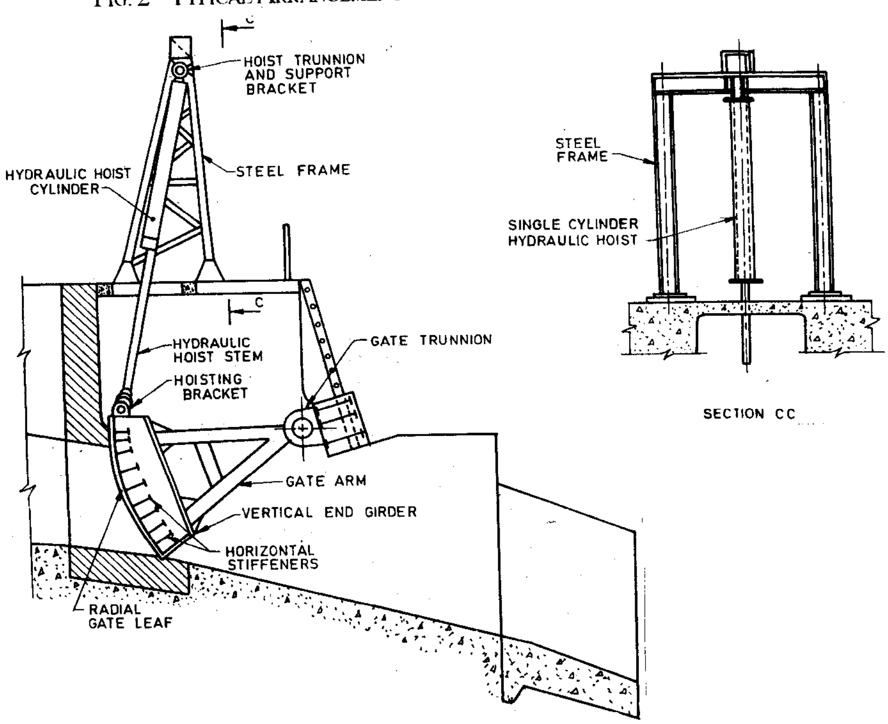


FIG. 3 SINGLE CYLINDER TYPE HYDRAULIC HOIST FOR RADIAL GATE

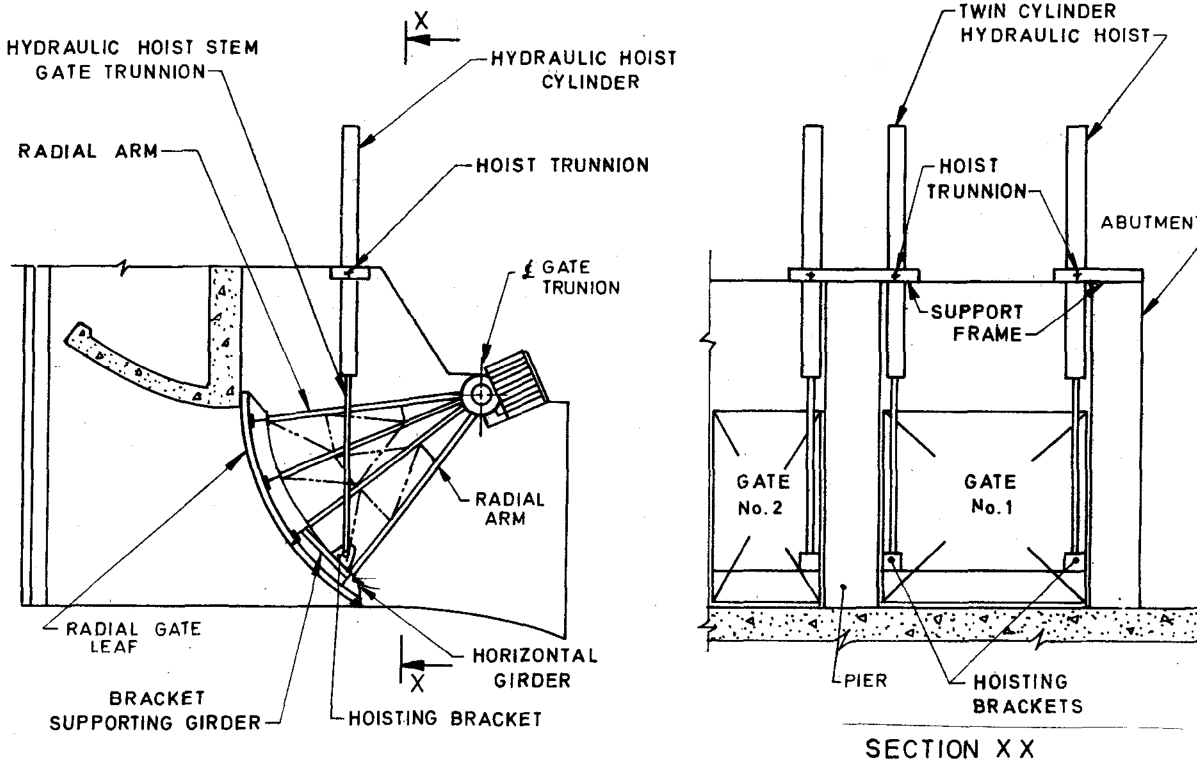


FIG. 4 TWIN CYLINDER TYPE HYDRAULIC HOIST FOR RADIAL GATE

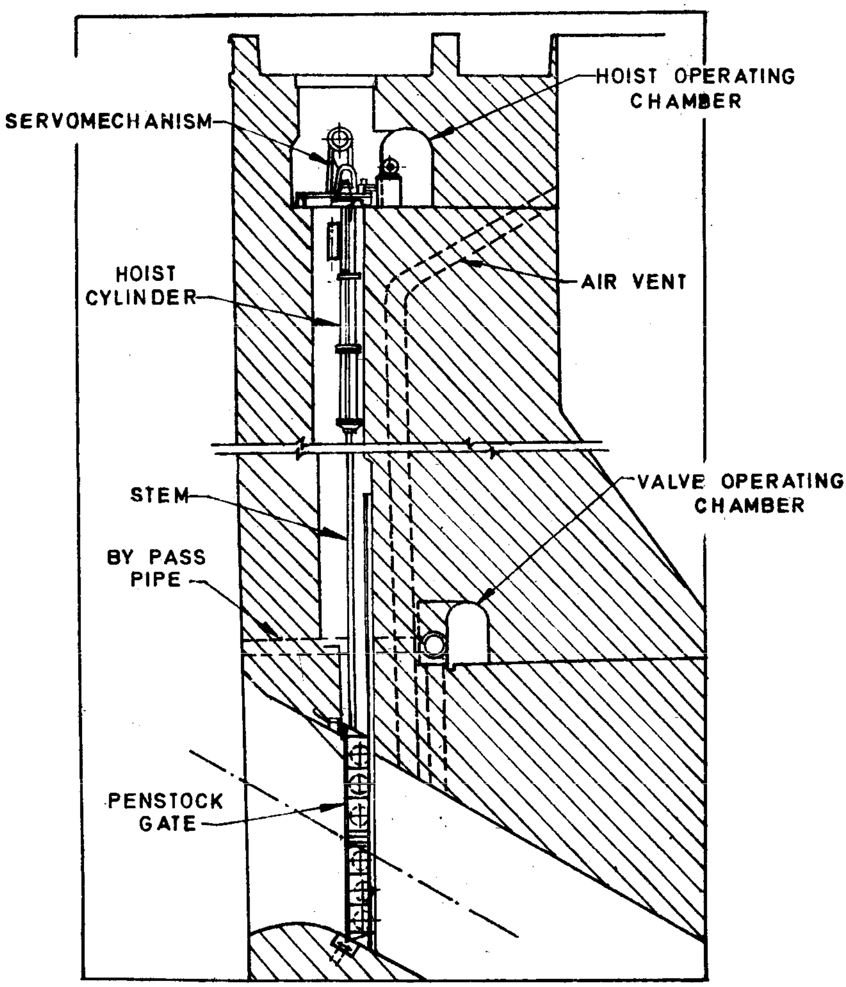


FIG. 5 TYPICAL ARRANGEMENT OF HYDRAULIC HOIST FOR PENSTOCK GATE

8.6 Piston Rings and Packings

8.6.1 The piston should be fitted with hydraulic type piston rings and also with a stuffing box having V-packing rings or other approved equivalent. These packing rings should eliminate leakage past the piston and permit holding of the piston in any position for long periods of time when outflow of oil from below the piston is blocked. The piston rings serve as a reserve seal in case of packing damage.

8.6.2 Repacking the piston with packing rings should require only the removal of upper cylinder head for access and not of the hoist.

8.7 Seals and Packings

8.7.1 For static seals, O-rings should be used and for sealing the moving parts V-type or other approved packings should be used. If required a wiper scraper may be provided to remove foreign matter from stems exposed to water to prevent damage to the packing as the stem enters the cylinder.

8.7.2 In case of double acting cylinders the sealing arrangement should be provided on the either side of the piston.

8.8 Hanger Stud

The hanger stud if provided should have its upper and screwed into and locked with the hanger nut while its lower end should be screwed into and locked with the piston. The hanger stud in its minimum cross-section should have sufficient strength to hold the load of the piston, piston stem and the gate. It should be designed to give way at its minimum cross-section, in case of an emergency, when lowering cycle under pressure is initiated without disengaging the hanger studs from the piston. Alternatively, hydraulically operated hanger stud may be provided.

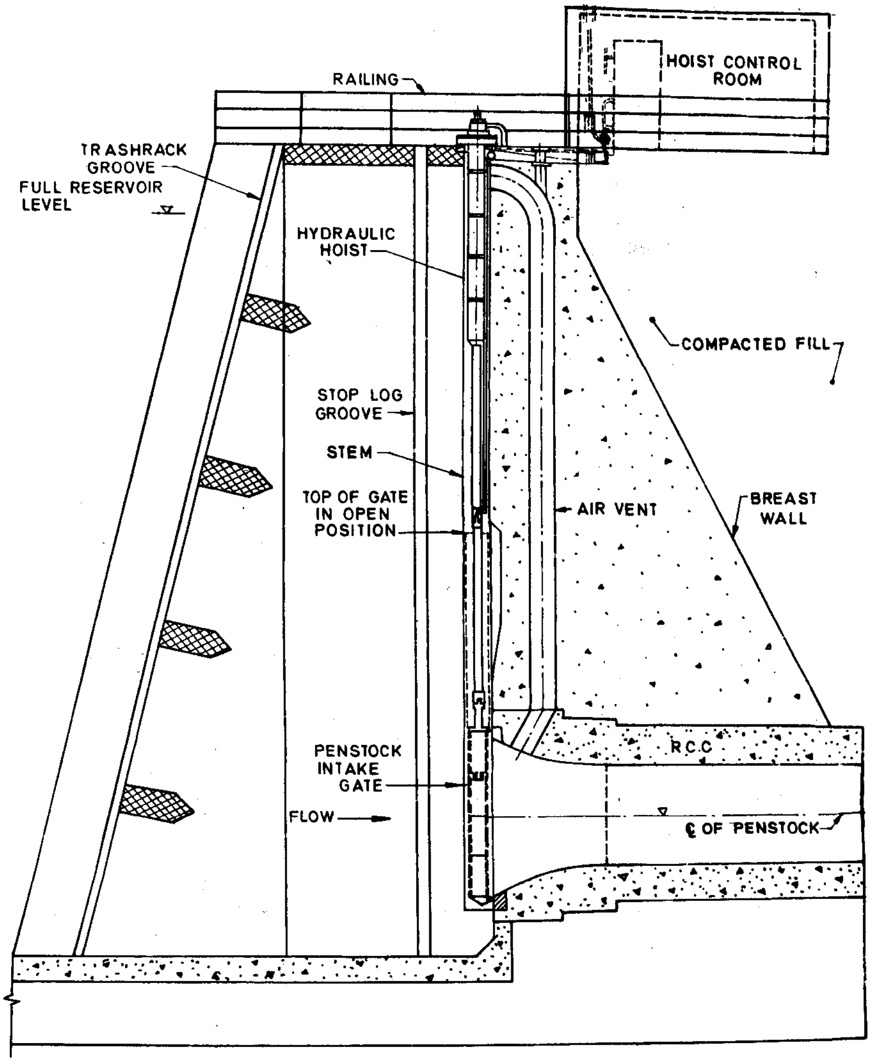


FIG. 6 TYPICAL INSTALLATION OF HYDRAULIC HOIST AT PENSTOCK INTAKE GATE

8.9 Gate Position Indicator

An indicator to show the position of gate in its full travel should be provided.

8.10 Test Pressure

The hoist cylinder, cylinder heads, pistons appurtenant piping, valve other parts and controls subjected to oil pressure should be tested at 150 percent of the operating pressure for a period not less than 30 min.

9 FABRICATION

9.1 The hoist cylinder should be composed of flanges of weldable forged steel; shell of pierced, rolled steel forging or a flat steel plate formed to cylindrical shape; joined to each other with not more than two longitudinal welds. If the cylinder is forged, the flanges should be forged as integral parts of the cylinder; otherwise the flanges of the cylinder should be butt welded to the cylinder shell. In either case, the cylinder should be annealed and stressed/relieved before machining. The interior surface of the cylinder should be ground, honed and polished. The ends of cylinders should be provided with proper chamfers for convenient insertion of the piston. All butt welds in the cylinder and cylinder heads should be tested for full strength by 100 percent radiographic examination.

9.2 As far as possible the entire cylinder shell should be in single piece.

9.3 The cylinder bore should be honed to a finish of 1.6 microns.

10 HYDRAULIC OPERATING SYSTEM

10.1 Components of Hydraulic-Electrical System

The hydraulic-electrical operating system should consist of the following basic components:

a) Oil tank;
b) Filter and strainers;
c) Pumps with motors and starting equipment;
d) Control valves which are manually, electrically, or hydraulically operated;
e) Pressure relief valve;
f) Piping;
g) Pressure gauge;
h) Pressure switches;
j) Push bottons, relays, and other electrical equipment for actuating and controlling the system; and
k) Stand-by pump and driving device as necessary.

10.1.1 Electric circuit should have the provision to take care of the creep of the gate owing to oil leakages at the cylinder inside seal or at the hydraulic control equipment, down to a predetermined position should be restored to its fully open position. Provision of audio and visual alarms in the restoring circuit should also be made.

10.1.2 Figure 8 shows the schematic arrangement of a typical hydraulic hoist system which can be adopted for operating penstock gates. The working of the system is given in Annex B.

10.1.3 When cold temperature are to be encountered, the hoist and components should be protected by heated enclosures.

10.2 Oil Tank

10.2.1 Oil tanks should have storage capcity considering the following:

a) Oil fully evacuated from one gate cylinder/cylinders at a time;
b) Displacement of oil due to piston stem of all the hoists;
c) 200 litres of spare oil or volume of one cylinder whichever is less; and
d) Free air space equivalent in volume to 200 litres of oil or volume of one cylinder, whichever is less.

Additional capacity should also be provided for the volumetric displacement of hoist stem and for temperature produced volume changes. In case a central oil tank is provided for all the gates at an installation, the capacity of oil tank should be sufficient to meet the above requirements, with each requirement being met independently.

10.2.2 Oil tank should be properly painted to ensure cleanliness and to avoid rusting. The tanks should be provided with breather openings. Provision should also be made to drain water accumulations from the lower points in the oil tank and hoist cylinder. It should be of robust steel construction and suitable for floor mounting. It should be provided with a filler cap, strainer and transparent gauge to indicate the level of oil in the tank. The filler cap should be a combination of air vent, dust screen and air filter.

10.3 Filters

Tank should be provided with screened filters. A filter with a screen not coarser than 150 microns should be provided in the pump suction line. A pressure filter should be provided in the return line to remove particles above 10 micron size.

10.4 Pumps and Motors

10.4.1 Two motor driven oil pumps should be provided for the operating system to ensure the operation of gate or valve, in case one motor-pump unit fails. The pumps should be vane/gear piston type.

10.4.2 The motor should conform to specified horse power, speed. It should be totally enclosed, flame proof, air cooled, direct driven with normal starting torque and low starting current, continuous rating, three phase squirrel cage induction type. The starter winding should have insulation specially treated to withstand wet and humid conditions, and should be suitable for the required altitude.

10.5 Valves, Pressure Gauge and Pressure Switches

The system should be provided with valves, pressure gauges and pressure switches as required to have an efficient and controlled working. These should conform to available Indian Standards.

10.6 Piping

10.6.1 Welded construction using socket welding fittings, O-ring flange type unions, and heavy walled tubing should be used for high pressure piping above 20 mm in size. For smaller sizes standard hydraulic tubing and O-ring type connectors should be used. Cold-drawn seamless tubing should be used for fabricating socket-welded piping.

10.6.2 The piping joints should be perfectly oil tight. The pipe lines should also have suitable bleeding arrangement.

10.6.3 Hydraulic control cabinet should be provided for mounting hydraulic control components. The cabinet should be suitably located depending upon operating conditions.

10.7 Electrical Control Equipment

10.7.1 Electrical control equipment, such as motor starters, relays, and breakers which may be susceptible to arcing should be physically separated in control cabinets from the hydraulic system and should be mounted in a separate compartment to avoid fire hazards. A 75 to 100 watt strip heater should be provided in the electrical compartment of the cabinet to prevent condensation of moisture on the electrical equipement.

10.7.2 The electrical control equipment should consist of all or any of the items like control transformers, miniature circuit breaker, H.R.C. fuses, control relays, selector switches, control switches, limit switches,

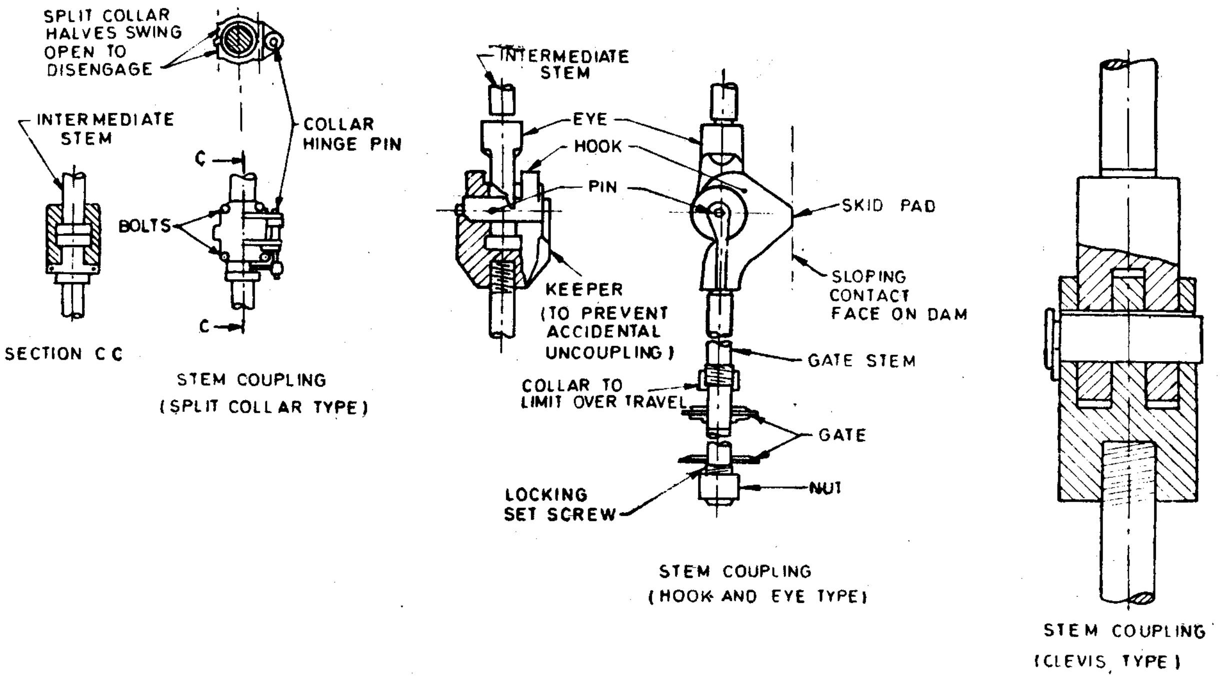
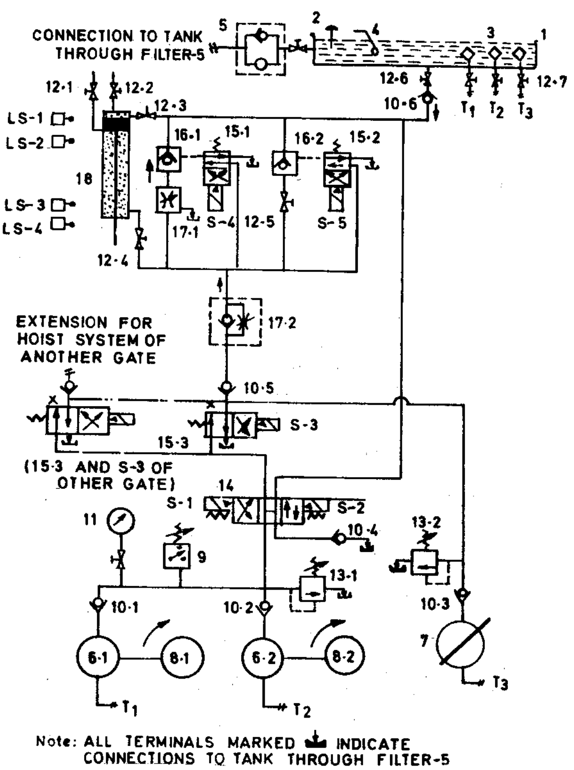


FIG. 7 VARIOUS TYPE OF COUPLINGS



List of Items

1 Oil tank
2 Air breather
3 Suction strainer
4 Float switch
5 Return line micronic filter
6 Vane pump
7 Hand pump
8 Electric motors
9 Pressure switch
10 Check valves
11 Pressure gauge
12 Shut-off valves
13 Relief valves
14 3-Position solenoid pilot operated direction control valve
15 3-Position solenoid pilot operated direction control valve
16 Pilot operated check valve
17 Flow control valve
18 Hydraulic cylinder
LS-1 to LS-4 Limit switches
S-1 to S-5 Solenoids

FIG. 8 TYPICAL HYDRAULIC HOIST SYSTEM FOR PENSTOCK GATE

push buttons, indicator lamps, local position indicator and alarm system adequate and suitable to achieve the required operation and control of the hoisting system.

10.7.2.1 All the controls should be so interlocked that the proper functioning of individual parts for the purpose is ensured.

10.7.2.2 The push buttons should be suitably labelled as 'Raise', 'Stop' 'Lower' or to meet other requirements.

10.7.2.3 In case of penstock gates to be lifted from sill by crack opening, further lifting of gate after crack opening is to be done after balancing the pressure on both sides of the gate.

10.7.2.4 The control system of hydraulic hoist in hydro power stations should be controlled by DC supply for emergency closing.

10.8 The hoist should be provided with a dampening device effective to the last specified distance of its travel so that the piston lands smoothly on the lower cylinder head.

10.9 Where the hoist gallery is subjected to moist conditions which affect the electrical installation the following are suggested to be provided:

1) Adequate ventilation,
2) The installation for the electrical equipments should be such that they function properly under moist conditions, and
3) Electrical equipments should be mounted in moisture proof and vermin proof housing.

11 HOIST SUPPORT FRAME

11.1 It should be designed to withstand the maximum load occurring at the time of operation of the gates. Wherever necessary, hydraulc hoist should be suspended from the hoist frame through a suitable hoist trunnion either of hinged or of rocking type hoist. Trunnions should be designed to safely take the load of the entire gate and the hoist assembly including oil. It should permit removal of the hoist cylinder without dismantling either the hoist support frame or trunnion.

12 ACCESS LADDERS AND PLATFORMS

12.1 Wherever necessary, access ladder for providing access to the top of each hoist cylinder, alongwith support platform and guard railing should be provided so as to permit approach to the top of each hoist for inspection and maintenance.

13 OIL

13.1 The oil should be suited to the viscosity and temperature range of operation.

ANNEX A

(*Clause* 2.1)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
210 : 1978	Grey iron castings (*third revision*)
226 : 1975	Structural steel (standard quality)
318 : 1981	Leaded tin bronze ingots and castings (*second revision*)
808 : 1989	Dimensions for hot rolled steel beam, column channel and angle sections (*third revision*)
1030 : 1989	Carbon steel castings for general engineering purposes (*fourth revision*)
1570 : 1961	Schedules for wrought steels for general engineering purposes
2002 : 1982	Steel plates for pressure vessels for intermediate and high temperature service including boilers (*first revision*)
2004 : 1978	Carbon steel forgings for general engineering purposes (*second revision*)
2041 : 1982	Steel plates for pressure vessels used at moderate and low temperature (*first revision*)
2062 : 1984	Weldable structural steel (*third revision*)
2825 : 1969	Code for unfired pressure vessels
6911 : 1972	Stainless steel plate, sheet and strip
9349 : 1986	Recommendations for structural design of medium and high head slide gates

ANNEX B

(*Clause* 10.1.2)

WORKING PRINCIPLE FOR HYDRAULIC SYSTEM FOR PENSTOCK GATE HYDRAULIC HOIST (*See* Fig. 8)

B-1 GENERAL

B-1.1 The system employs two similar vane pumps/gear pump/piston pumps (items 6.1 and 6.2) drawing oil from the oil tank (item 1) through suction strainers (item 3). The use of two pump sets enables the system to be kept operative at half the speed, in case one pump set fails. The pumps are coupled to electric motors of suitable horse power. Further a hand pump or diesel engine driven pump may be provided as an emergency measures in case of electric supply failure.

The hydraulic cylinder used for penstock gates may be used as double acting for release of items for connecting/delinking of link by using normally closed (NC) gate valves with setting up maximum pressure of 10 bar during this cycle.

The system employs solenoid operated direction control valves, making it possible to operate the cylinder from remote push button.

B-1.2 Working

This is described in four distinct phases as given in **B-1.2.1** to **B-1.2.4**.

B-1.2.1 *Idle*

With all the solenoids in de-energized condition, the electric motors are started. The pump output flows freely back into the reservoir through the check valves (items 10.1 and 10.2), the solenoid pilot controlled direction control valve (item 14), check valve (item 10.4) and return line micronic filter (item 5).

B-1.2.2 *Opening*

Solenoids (item S-2) and (item S-3) are energized. This shifts the respective valve spools and the pump flow is directed to the rod end of the cylinder through check valve (item 10.5), flow control valve (item 17.2) and shut off valve. The piston rises and pushes out the flow from the head end of cylinder through the valves (items 12.3, 14 and 10.4). The speed of raising can be controlled by the flow control valve. The relief valve limits the operating pressure and protects the system from overload. The piston continues to rise till the limit switch (item LS-1), is struck by a tapper fixed to the moving gate assembly. At this point the solenoids are de-energized, the piston stops moving and system reverts to idle.

B-1.2.3 *Closing*

The closing takes place in two phases:

a) *Fast Closing* — Since in a penstock gate, the initial lowering or closing of gate has to be very rapid, that oil from the rod end of cylinder is allowed to escape from the cylinder at a fast rate and the gate falls under gravity and hydraulic downpull acting on it. To achieve this, the solenoids (items S-1 and S-5) are energized. Pump oil is directed to head end of cylinder. The rod end oil passes through the valves (items 12.4 and 12.5), the pilot operated check valve (item 16.2), the valve end, and into the head end of cylinder due to the falling piston. In case the rod end oil and pump oil are not sufficient to fill up the vacuum caused, the check valve (item 10.6) opens to draw the rest of the oil from the reservoir.

b) *Slow closing* — Towards the end of the closing stroke, it is desirable to slow down the speed of the gates to have a dampening effect. This is achieved in this circuit by operating the limit switch (LS-3) by the moving gate. The limit switch, when strike the de-energized the solenoid (S-5), it energizes the solenoid (item S-4). The flow from the rod end then has to flow to head end of cylinders through the valves (items 17.1, 16.1 and 12.3). The flow control valve (item 17.1) has an adjustable passage much smaller than that of pilot operated check valve (item 16.2). Thus the rate of escape of oil for the rod end of cylinder is reduced and the piston moves at a slower speed till lowest limit switch (LS-4) is struck. At this point all solenoids are de-energized and the gate comes to rest, the hydraulic system reverts to idle state. Here also the relief valve protects the system from overloading.

B-1.2.4 *Emergency Operation*

The hydraulic system allows the gate to be operated even in the case of power supply failure, as under:

a) *Opening* — By operating the hand pump (item 7), the oil can be directed to rod end of cylinder to raise the piston. The head and oil will flow to tank through valves (items 12.3, 14 and 10.4).

b) *Closing* — The solenoid valves (items 15.1 or 15.2) are so designed that their spools can be shifted manually also. This has the same effect as of energizing the solenoid (items S-4 or S-5). The gate can, therefore, be lowered, the head end of cylinder being filled up by the oil drawn from reservoir through check valve.

B-1.3 Special Features

Some important aspects of the system other than normal operations are as described in **B-1.3.1** to **B- 1.3.7**.

B-1.3.1 *Air Vent*

When the cylinders are initially installed, it is necessary to first vent the air out from the head end of cylinder.

This is done by opening vent valve (item 12.2) and raising the piston under pressure to push out the air on top of it. When the piston has reached the top of its stroke, vent valve (item 12.1) can be opened to release any air trapped below the piston. After removing the air the vent valves are shut off. Similarly, when the cylinders are emptied of oil during maintenance, the air is to be removed while re-commissioning the unit.

B-1.3.2 *Creep*

When the gate is left standing in any intermediate position for a good length of time, it is quite possible that under the weight of the moving parts, oil from the rod end side will leak past the piston to the top of the piston. This leakage rate will be very slow, but if this occurs, the gate will slowly creep down. In such a case, it is desirable to employ a limit switch (LS-2) the position of which can be pre-set to the allowed amount of creep (say 100 to 150) when the moving gate operates the limit switch. The appropriate solenoids will be energized to raise the gate again to the top limit switch (LS-1). The limit switch (LS-2) can also be employed usefully to sound an alarm.

B-1.3.3 *Famming of Gate*

In case the gate jams and it is beyond the capacity of the hydraulic hoist to lift it, pressure will rise to the setting of the relief valve and the pump oil will return to tank without overloading the hoist system. However, to enable the operator to know that such a jamming has taken place, a pressure switch (item 9).can be usefully employed. By keeping its setting near about the pressure, it can sound an alarm or activate some other device. The pressure exerted by the hoist can be seen directly from the pressure gauge (item 11).

B-1.3.4 *Holding up of Gate in any Intermediate Position*

During normal operation, the gate will travel its complete length of stroke when appropriate push button is depressed. However, it is also possible to have a selection switch in the electrical panel, which will enable the gate to be moved only as long as the push button is kept depressed. In other words, the gate can be stopped in any intermediate position.

B-1.3.5 *Gravity Closure*

In case the gate can be closed under gravity, it is not necessary to force down the position under pump pressure and gate closing system can be modified accordingly.

B-1.3.6 *Position Indicator*

A rotary or linear position indicator can be linked to the moving parts of the gate to indicate its position.

B-1.3.7 *Hanger Stud*

A hanger stud provided in the cylinder head can support the weight of the piston and piston stem and gate when the cylinder is empty of oil. In more sophisticated system, the hanger stud can be hydraulically operated and provided with a spring loaded latch so that the piston is automatically locked up in its top position everytime it completes the stroke. The lock will be automatically opened hydraulically when the down push button is pressed for lowering the piston.

Standard Mark

The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

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